P a t e n t   c l a i m s

1.   A method of transporting a first data stream of a
first bit rate through a Synchronous Digital Hierarchy
(SDH) switched network from a first endpoint to a second
5   endpoint,
c h a r a c t e r i z e d   i n

   a)   demultiplexing the first data stream from the
        first endpoint onto a number of Single pair High
        speed Digital Subscriber Lines (SHDSLs) each
10   having a second data stream of a SHDSL adjusted
        second bit rate,

   b)   mapping each of the second data streams into data
        bit and/or unused overhead bit positions of SDH
        specified data containers,

15   c)   multiplexing the data containers into the SDH
        switched network.

2.   Method according to claim 1,
c h a r a c t e r i z e d   i n

   d)   inverting the steps a) - b) to retrieve the first
20   bit rate at the second endpoint side.

3.   Method according to claim 1 or 2,
c h a r a c t e r i z e d   i n   that, in each of the
second data streams, there is included an overhead of a
third bit rate incorporating e.g. framing words, alarm
25   indication and/or transmission quality measurement.

4.   Method according to claim 3,
c h a r a c t e r i z e d   i n   that at least a part of
the overhead includes frame synchronisation words for
measuring delay differences between the SHDSL lines for

thereby securing end-to-end integrity of the second data streams.

5.   Method according to one of the preceding claims, c h a r a c t e r i z e d   i n   that the data containers are C-12 containers with a bit rate of 2.176 Mbit/s.

6.   Method according to claim 5, c h a r a c t e r i z e d   i n   that the data bit positions are C-12 D-bit positions and the unused overhead bit positions are C-12 R-bit positions.

7.   Method according to one of the preceding claims, c h a r a c t e r i z e d   i n   that the number of SHDSLs is four, and the second bit rate is 2.120 Mbit/s.

8.   Method according to claim 7, c h a r a c t e r i z e d   i n   that the first bit rate is 8.448 Mbit/s and the third bit rate is 8 Kbit/s.

9.   Method according to claim 7 or 8, c h a r a c t e r i z e d   i n   that the R-bit positions being used are 8 R-bit positions in each of byte 34, 68, 102 and 136 in addition to bit number 7 in byte 1, 35, 69, and 103.

10.   Method according to claim 1, c h a r a c t e r i z e d   i n   that the first bit rate is X Mbit/s, the second bit rate is ix8kbit/s (i∈[1,7]) plus nx64kbit/s (n∈[1,36]) and the number of SHDSL lines are X, and the numbers of datacontainers are N wherein N and X are any integer number.

can be achieved by the use of 8 R-bits in byte number 34,
68, 102, 136 and bit number 7 in byte 1, 35, 69, 103. In
this way, exactly all the R-bits that is repeated in all
blocks (in byte 103, only bit number 7 is an R-bit) are
5   being used to achieve the required bit rate of 2.120
Mbit/s.

The principle of inverse multiplexing a E2 8.448 Mbit/s
across a SDH network as described for the preferred
embodiment can also be used for any E2 transmission access
10   system like the radio and fibre optical systems of Sonet.
In general, the present invention discloses a method for
transporting a SHDSL transmission frame over a SDH network
using inverse multiplexing of VC's and SHDSL transmission
lines. The transport in SDH can either be done via VC-12 as
15   described above, or via VC-11 according to the North
American standard. Any combination of ix8 kbit/s and
nx64kbit/s as defined in the SHDSL standard can be
transported. According to the present invention, extra
available stuffing capacity in the VC-11/12 overhead is
20   used to match the actual bit rates. Fig. 3 shows an
overview of the general concept.

The main advantage of the present invention is that it
allows transport of the not standardised data rates between
2 Mbit/s and 34 Mbit/s through a SDH switched network. This
25   is provided with a minimum of additional processing by
fragmenting the data stream onto SHDSL lines and adopting
the free space capacity in the C-12 containers.

A part of the above-mentioned overhead is the SHDSL frame
synchronisation word. This frame overhead is used for the
purpose of measuring the delay difference between the lines
in order to secure the end-to-end integrity of the SHDSL

5   signal. The transmission quality and alarm measurement is
end-to-end transparent throughout the connection of fig. 1
including both the SHDSL and SDH sections, as it should be
possible with the present invention to transport the
overhead through the SDH section.

10   As already indicated the VC-12 container is transparently
through connected in a SDH switching network. The total
capacity of a VC-12 is 2.240 Mbit/s and the standard
defines how an E1 signal with 2.048 Mbit/s is transported
in such a container.

15   Within a VC-12, the 2.048 Mbit/s data is mapped into a C-12
container. The C-12 container is shown in Fig. 2. The
actual bit rate of the C-12 container is 2.176 Mbit/s, but
the data rate of the payload (D-bits) is accurate 2.048
Mbit/s. The C-12 container is divided into 4 blocks, each

20   of 34 bytes length and of 125□s duration.

As can be seen from fig. 2, in addition to the E1 data bits
(D), there are overhead bits giving a total bit rate of
2.176 Mbit/s for the C-12 container. However, most of the
other bits (R-bits) are fixed and unused by the standard.

25   According to the present invention this extra capacity is
being used to increase the payload capacity of the C-12
container.

Therefore, to transport the 8.448 Mbit/s bit stream, the
rate of each of the four transmission systems needs to be

30   2.120 Mbit/s, i.e. 72 kbit/s extra compared to the payload
bit rate of 2.048 Mbit/s. This capacity is achieved by the
use of the extra R-bits in the C-12. Since each block has a
duration of 125 □s, there are 8 blocks in one second, and
totally (72 kbit/s * 1/8 s) 9 R-bits will be needed. This

Detailed description of the present invention

In the following, a preferred embodiment of the present
invention will be described and thereafter showing how the
invention may be utilised in a more general way.

5   As already mentioned no standard for transporting bit rates
between 2 Mbit/s and 34 Mbit/s in SDH exists. This is a
problem especially because the bit rate of 8 Mbit/s is a
common bit rate e.g. for end users' broadband connections.
Thus, the preferred embodiment of the present invention
10 discloses a solution for transporting a data rate of
approximately 8 Mbit/s through an SDH network.

For Single pair High Speed Digital Subscriber Line (SHDSL),
however, it is defined a data formatting structure for the
insertion of an overhead channel and data interleaving
15 method for single and dual line pair transmission. The
present invention uses this as a basis when demultiplexing
a 8.448 Mbit/s E2 bit rate into a quad line system as shown
in fig. 1, and using a payload bit rate of 2.112 Mbit/s on
each line giving a total capacity of the accurate E2 bit
20 rate.

Further, on each line there is added an overhead of 8
Kbit/s giving each line a total rate of 2.120 Mbit/s. This
overhead incorporate a framing word, alarm indication and
CRC transmission quality measurement.

25 The transparent data of a SDH system is structured in so-
called containers, in the preferred embodiment this is a
VC-12 container. For transporting the data of the SHDSL
lines over SDH, this is done by taking into use some of the
free space capacity in a VC-12 container in order to
30 transport the complete SHDSL payload and overhead end-to-
end. The VC-12 containers are then multiplexed into the SDH
transport network, and the inverse procedure is executed at
the receiving side as indicated in fig. 1.

Summary of the invention

It is an object of the present invention to provide a
method that eliminates the drawbacks described above. The
features defined in the independent claim enclosed
5   characterise this method.

In particular, the present invention discloses a method of
transporting a first data stream of a first bit rate
through a SDH switched network from a first endpoint to a
second endpoint by demultiplexing the first data stream
10   from the first endpoint onto a number of SHDSL lines, each
having data streams of a SHDSL adjusted bit rate mapping
each of the data streams into data bit and/or unused
overhead bit positions of SDH specified data containers,
and multiplexing the data containers into the SDH switched
15   network.

Brief description of the drawings

In order to make the invention more readily understandable;
the discussion that follows will refer to the accompanying
drawings.

20   Figure 1 shows a block diagram of an end-to-end connection
according to a preferred embodiment of the present
invention,

Figure 2 shows a SDH C-12 container for transport of E1
signals on 2.048 Mbit/s,

25   Figure 3 shows a block diagram of an end-to-end connection
according to a general embodiment of the present invention.

METHOD OF TRANSPORTING DATA STREAMS THROUGH AN SDH SWITCHED NETWORK

Field of the invention

The present invention is related to data communication
5   systems, in particular to a method transporting certain bit
rates through Synchronous Digital Hierarchy (SDH).

Background of the invention

SDH is a well-established signal distribution system for
transferring multi-gigabit rates over transporting networks
10 e.g. in fixed telecommunication networks and radio access
networks of mobile telephone systems. Plesiochronous
Digital Hierarchy (PDH) is an older system offering lower
bit rates, but it is still being widely used e.g. in data
transport towards broadband end users.

15 Transition mechanisms for transferring PDH bit rates into
SDH exist. The basic principle for this can be found in the
ITU G.707 recommendation. In addition to this, it is also
defined standards for how to transport SDH elements in PDH.
The ITU recommendation G.832 defines this for 34 Mbit/s up
20 to 140 Mbit/s transmission.

However, no standards for the transport of bit rates in the
area between 2 Mbit/s and 34 Mbit/s are defined for SDH. A
problem then obviously appears when the PDH standard E2 for
8 Mbit/s is being used.

25 The application WO9409577 discloses a system arranged to
operate at rates below 140 Mbit/s in SDH, still being
compatible with PDH. However, the application does not give
any further details on how to solve this problem other than
indicating some kind of utilization of overhead capacity.